

Cytotaxonomic Study of Ferns from China II. Species of Fujian

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(Received on August 8, 2001)

A cytotaxonomic study of ferns from Fujian Province, China, was carried out. The reproductive modes of 31 species in 18 genera were examined using a conventional method, and the chromosome numbers were counted for 24 species, including 12 newly examined in China. The chromosome numbers of both *Lygodium microstachyum* and *L. scandens* are $2n = 60$. *Pteris semipinnata* is a sexual tetraploid with $2n = 116$ chromosomes, while *P. esquirolii* has $2n = \text{ca. } 90$ chromosomes and is considered to be an agamosporous triploid. Five species were observed in *Dryopteris*, all of them being agamosporous. *Deparia japonica* has been recorded from Japan as a hexaploid, with $n = 120$ chromosomes but this study reports a sexual tetraploid with $2n = 164$ chromosomes from Fujian. *Thelypteris glanduligera* and *T. parasitica* are agamosporous triploids with $2n = 108$ chromosomes. (Continued from J. Jpn. Bot. 71: 214–222, 1996)

Key words: agamospory, Fujian Province, reproductive mode, pteridophyta.

In studies of the biodiversity and systematics of Asian pteridophytes, cytological information from Chinese ferns is indispensable. Although more than 300 Chinese pteridophytes have been studied cytologically by both Chinese and overseas researchers (Lin et al. 1996), this is only around 10 % of the 3000 or so species found in China. Lin et al. (1996) have previously performed a cytotaxonomic study of Chinese ferns (Series I) from Yunnan. As the continuance, in the present study, we carried out cytological observations on material from Fujian.

Fujian Province is located in the southeastern coastal area of China. The variable landforms and warm, humid climate provide Fujian with various ecosystems, which support an abundance of plant diversity.

Obviously, Fujian is also one of the provinces with a rich pteridophyte flora. Four hundred and four species (including 25 endemic) of ferns and fern-allies have been recorded in Fujian [Lin et al., 1982, following Ching's system (1978)]. Approximately 37 % of the total Fujianese species range to Japan, and more than 12 % of the species to Taiwan. As far as we know, the Fujianese pteridophytes have never been investigated cytologically, with the exception of a few *Dryopteris* species (Weng 1989).

As a first step in the systematic studies of Fujianese pteridophytes, we report here the chromosome numbers of 24 species and reproductive modes of 31 species. The chromosome numbers of some species are counted for the first time in China. The present study expects to contribute to our wider

knowledge of the Chinese ferns, and to make possible a comparative study of the pteridophyte floras of East China and Japan.

Materials and Methods

As shown in Table 1, materials were collected from the Linshi Forest center of Fuqing, the Forest Park of Fuzhou, and of the Gushan mountain in Fuzhou, southeast of Fujian. Voucher specimens are deposited in the Herbarium, the Bioengineering College, Fujian Teacher's University.

Fresh root tips were pretreated with 0.002 M 8-hydroxyquinoline solution for 4–6 hours at 18–20°C, and then fixed in 3 : 1 acetic acid: alcohol (99 %) in the field, for observation of somatic chromosomes. The observation method follows Lin et al. (1996). Frond material was fixed in K'nop solution for gametic observation and spore counting. Dry specimens were also used for spore counts, with more than 10 sporangia being counted for each individual.

Results and Discussion

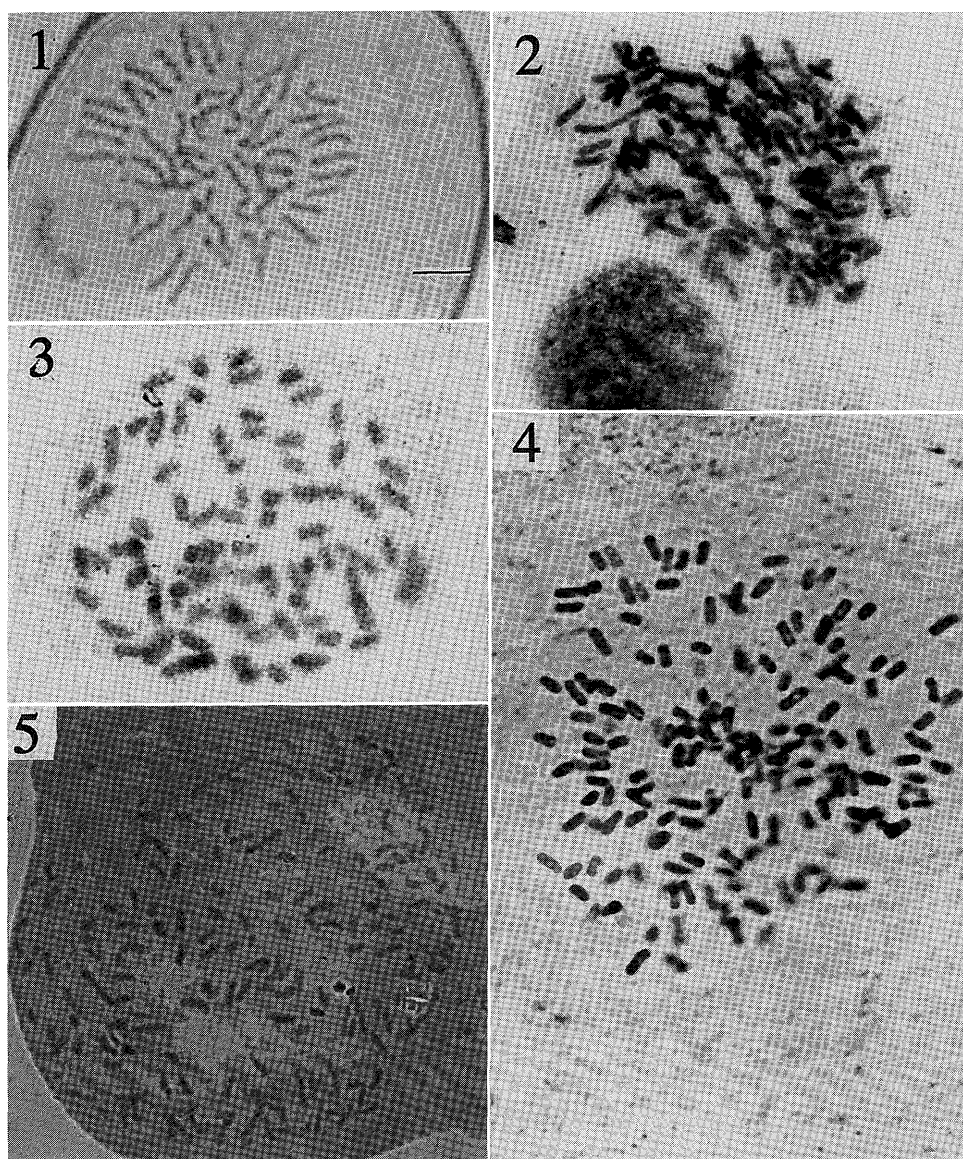
The results are shown in Table 1 and Figs. 1–18. The somatic chromosomes of 24 species belonging to 14 genera of 10 families were examined and the reproductive modes of 31 species of 18 genera were inferred by spore counting. The frond materials were used for spore counts as the young spores in each unopened sporangium can be counted exactly. However, fronds were too old to be used for gametic chromosome counting in the present study. Dry specimens were used for spore counts in those species for which we did not have suitable frond material. In most higher leptosporangiate ferns, 64 haplospores are produced in each sporangium in sexually reproductive species, while 32 diplospores are produced in each sporangium in agamosporous species. A few sexual, 32-spored groups, such as lindsaeoid ferns, are the exceptions (Lin et al. 1990). Thus, spore counts can be used for inferring

reproductive modes (Yoroi and Iwatsuki 1977, Murakami and Iwatsuki 1982, Kato et al. 1992). The presence of 32 spores per sporangium is supporting evidence for distinguishing agamospory from the normal sexual type with 64 spores per sporangium. In cases where spores escaped from the split sporangia of dry specimens, the spore number was estimated to be 64 based on practice counts of more than 32 in each sporangium. On the other hand, if the practice count was lower than 32, it was considered to be 32-spored.

In the present study, the chromosome numbers of 12 species were newly reported for China. Cytotaxonomically noteworthy species are described and discussed below.

Lygodium About 40 species of *Lygodium* are recorded worldwide (Iwatsuki 1992). Only a few species have been studied cytologically, the basic chromosome numbers of the genus being variously reported as $x = 28, 29$ or 30 (Mitui 1965, 1968, Kurita 1967, Tsai and Shieh 1983, Roy and Rao 1985, Walker 1985, Singh and Roy 1988, Nakato 1990, Ammal and Bhavanandan 1992, Takamiya 1995).

There are eleven species of *Lygodium* in China, four of which are found in Fujian, but no previous cytological data were available for them. In the present study, two species, *L. microstachyum* Desv. and *L. scandens* (L.) Sw., were observed cytologically. The chromosome numbers of both species were recorded as $2n = 60$. This coincided with the numbers $n = 30, 2n = 60$ of *L. scandens* from Nepal (Srivastava 1985), but not with $n = 29$ in *L. microstachyum* of Taiwan (Tsai and Shieh 1983). In Japan, *L. microstachyum* is distributed in the south of the Ryukyus, and is considered to be a variety of *L. japonicum* (Thunb.) Sw. ($n = 29, 2n = 58$). To determine the correct base number and the relationship between *L. microstachyum* and *L. japonicum*, further research is encouraged.

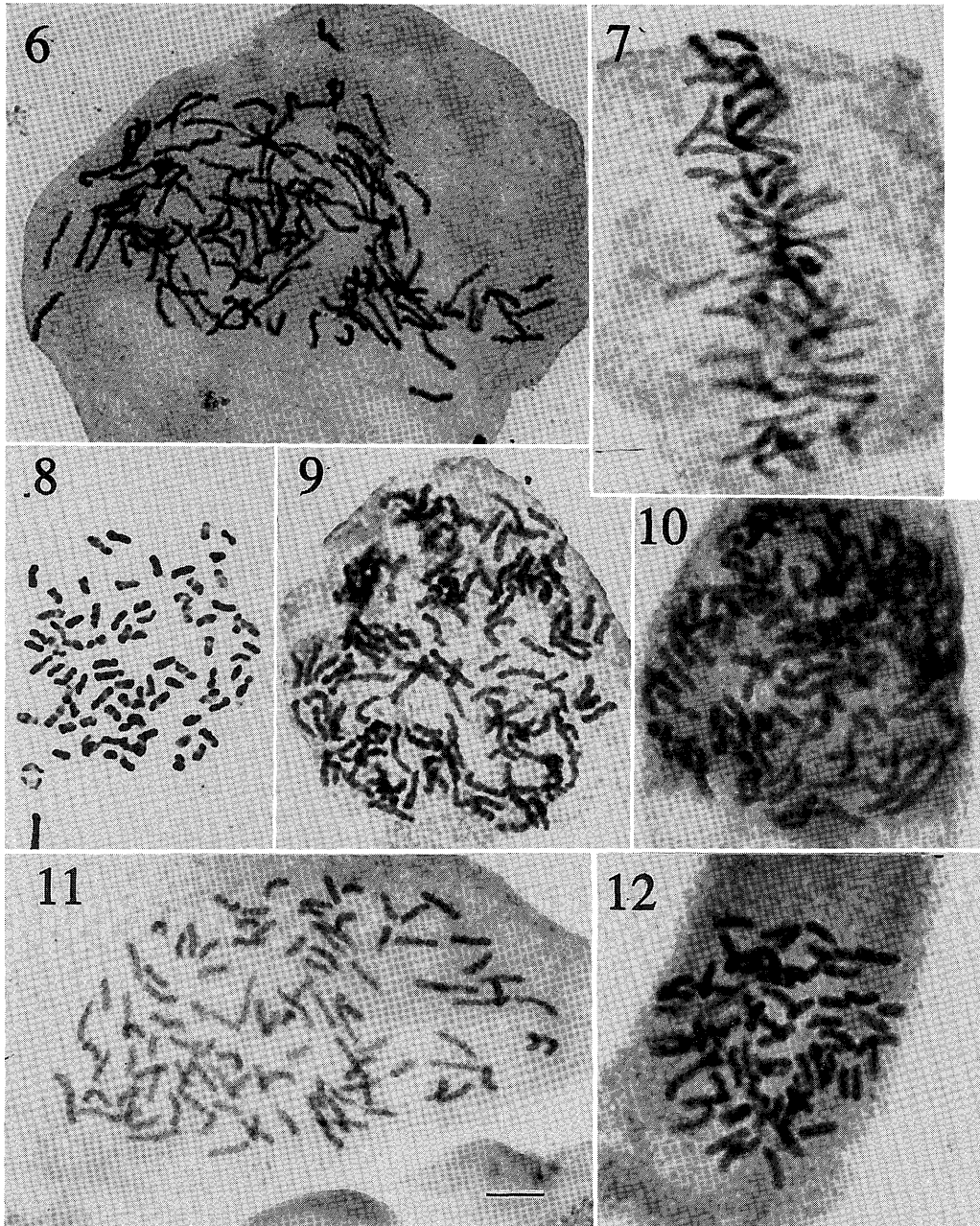


Figs. 1–5. Photographs of somatic chromosomes. Scale bar = 10 μm . 1. *Lygodium microstachyum* $2n = 60$. 2. *Microlepia marginata* $2n = \text{ca. } 164$. 3. *M. strigosa* $2n = 84$. 4. *Lindsaea orbiculata* $2n = 176$. 5. *Sphenomeris chinensis* $2n = \text{ca. } 190$.

Microlepia *Microlepia* is a well-known genus in Asia. About 81 % of the 70 known species have been recorded from China, five of these being recorded from Fujian. Only four Chinese species were studied cytologically by Weng (1985b), Weng and

Qiu (1988), Kato et al. (1992), Nakato et al. (1995) and Kato and Nakato (1999) in these studies, the basic numbers were considered to be $x = 42$ or 43.

Two species, *M. marginata* and *M. strigosa*, were collected for this study.



Figs. 6–12. Photographs of somatic chromosomes. Scale bar = 10 μm . 6. *Pteris semipinnata* $2n = 116$. 7. *Woodwardia japonica* $2n = 68$. 8. *Arachniodes exilis* $2n = 82$. 9. *Dryopteris gushanica* $2n = 123$. 10. *D. varia* $2n = 123$. 11. *Thelypteris glanduligera* $2n = 108$. 12. *T. acuminata* $2n = 72$.

Cytologically, triploids, tetraploids and hexaploids have been reported in *M. marginata* from China, Taiwan and Japan (Mitui 1968, Nakato and Serizawa 1981, Tsai and Shieh 1983, Weng 1985b, Weng and Qiu 1988, Nakato et al. 1995). For Chinese materials, the chromosomes were counted as $n = 86$ by Weng (1985b) and Weng and Qiu (1988) from Zhejiang Province and $2n = 168$ by Nakato et al. (1995) from Jiangsu Province. *Microlepia marginata* is a morphologically variable and very common species in Fujian. Our chromosome and spore counts showed $2n = \text{ca. } 164$, and about 58 (64) spores in each sporangium in *M. marginata*, so we suspect it to be a sexual tetraploid.

Microlepia strigosa is widespread in the Asian tropics. In Japan, its chromosome numbers have been reported as $n = 43$, $2n = 86$ by Mitui (1965, 1968, 1973, 1976), Sasamoto (1970) and Kurita (1972), and $2n = 84$ by Kawakami (1979), Nakato and Serizawa (1981). Tsai (1992) reported $n = 43\text{II}$, 86II , $2n = 86$, 172 from Taiwan. In the present observation, however, the chromosomes were counted as $2n = 84$, which is a new record from China. These results suggest it should be considered a sexual, diploid species according to both chromosome and spore numbers (Table 1).

Pteris *Pteris* is a large genus with about 300 species in the world, including about 110 species in China. In Fujian, sixteen species have been recorded.

Cytological and systematic studies of Chinese *Pteris* were performed by Chiu (1981), Wang (1989), Weng (1985a, 1990), Weng and Qiu (1988), Kato et al. (1992), Nakato et al. (1995), Lin et al. (1996), and Kato and Nakato (1999). Although only about 10 % of Chinese species are known cytologically, the occurrence of diploid, triploid and tetraploid cytotypes and sexual and agamosporous reproductive modes give

a good explanation for the extreme diversity seen in this genus.

Pteris esquirolii was cytologically observed here for the first time in China. Based on the chromosome number $2n = \text{ca. } 90$, and about thirty-two spores in each sporangium, it is suggested to be an agamosporous triploid in Fujian.

Woodwardia japonica Except for a single report ($n = 17$) from Zhejiang (Weng and Qiu 1988), *Woodwardia japonica* has always reported as a sexual, diploid species with $n = 34$, $2n = 68$ chromosomes in China and Japan (Mitui 1965, 1968, Takamiya et al. 1992, Nakato et al. 1995). The Fujianese materials were counted to be $2n = 68$ here, too. Conventionally, the basic chromosome number of *Woodwardia* is considered to be $x = 31$, 34 . As Takamiya et al. (1992) pointed out, if the lowest number is really 17, these species (including *W. japonica*) usually referred to diploid should be considered as tetraploids.

Dryopteris About 300 species have been recorded for *Dryopteris* in China, of which about sixty species have been observed cytologically (Chiu 1981, Wang and Zhang 1981, Wang and Xia 1984, Wang 1985, Weng 1985a, 1989, Nakato et al. 1995), most of which (more than 60 %) were agamosporous triploids.

As Table 1 shows, five species of *Dryopteris* were observed here, three of them are new cytological records for China. All of them are agamosporous triploids, except for *D. hwangii* Ching, for which, an estimated 80 chromosomes and 29–32 spores in each sporangium suggest it was an agamosporous diploid species, no matter despite the fact that the chromosome number could not be counted exactly. It was clearly showed that agamosporous triploids are predominant in the evolutionary diversity of Chinese *Dryopteris*.

Table 1. Materials and chromosome numbers of fern plants from Fujian, China

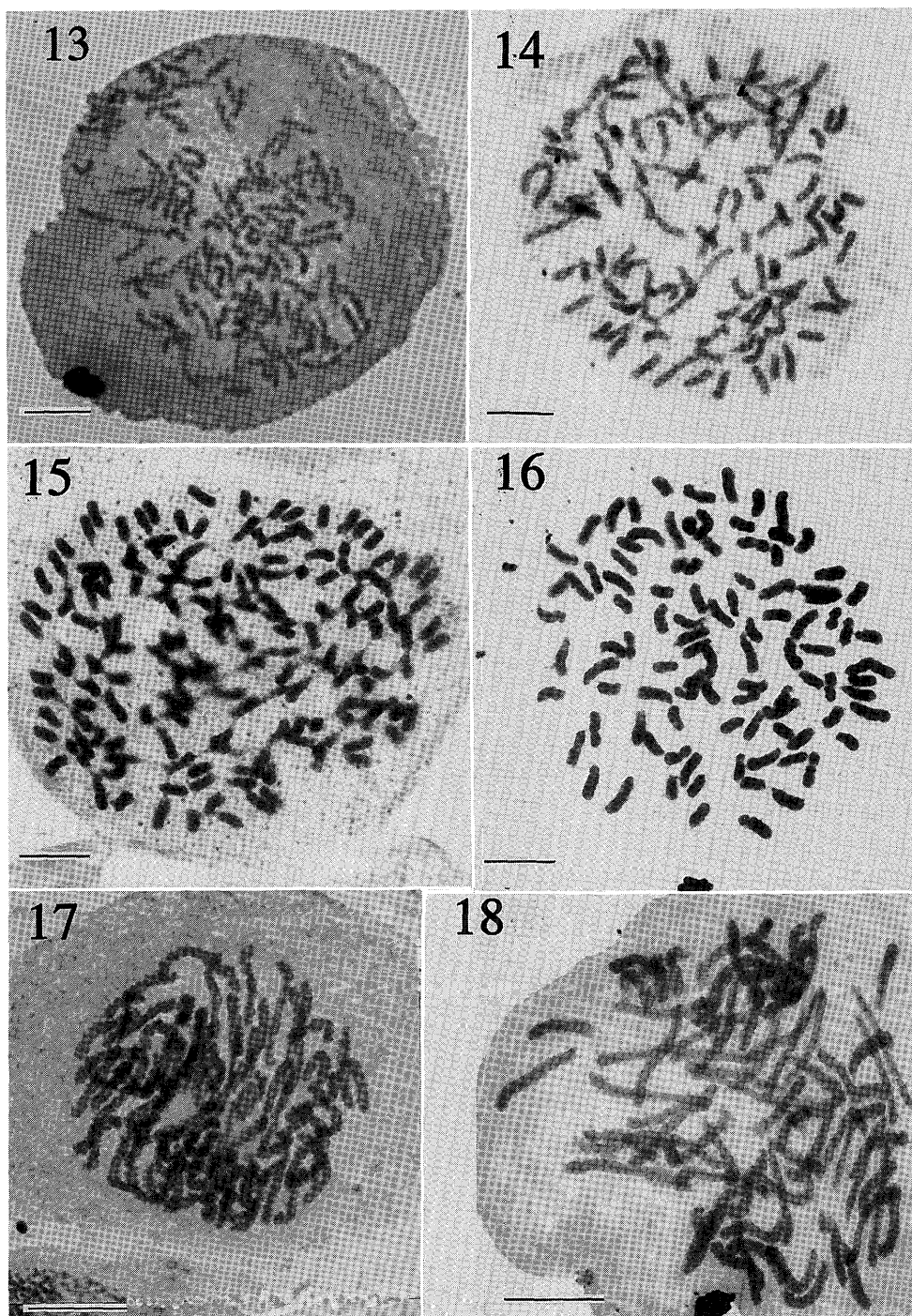
Family & species	Voucher	S/S	Chromosome no. (2n)	Sexuality & ploidy	Photo no.	Family & species	Voucher	S/S	Chromosome no. (2n)	Sexuality & ploidy	Photo no.
Schizaceae						<i>A. rhomboidea</i> (Wall.) Ching	97-48, 49	56, 63 (64)		sex., 4x?	
<i>Lygodium</i> (x = 29, 30)						<i>Dryopteris</i> (x = 41)					
* <i>L. microstachyum</i> Desv.	96-27	100-102	60		1	<i>D. championi</i> (Benth.) Ching	97-3, 8, 10, 11, 27, 30, 34, 41, 42	30, 30, 28, 30, 30, 30, 30, 32, 30	c. 123	apo., 3x	
* <i>L. scandens</i> (L.) Sw.	97-17	95	60								
Dennstaedtiaceae						* <i>D. dehuaensis</i> Ching	97-37	25 (32)	≥ 120	apo., 3x	
<i>Microlepia</i> (x = 42, 43)						* <i>D. gushanica</i> Ching	97-24, 28	32, 29	123	apo., 3x	9
<i>M. hancei</i> Prantl	97-19	64		sex.		* <i>D. hwargii</i> Ching	96-7	29-32	c. 80	apo., 2x	
<i>M. marginata</i> (Houtt.) C. Chr.	97-20, 97-36, 44	58, 58, 58 (64)	c. 164	sex., 4x	2	<i>D. varia</i> (L.) O.Kuntze	97-7, 54	32, 32	123	apo., 3x	10
* <i>M. strigosa</i> (Thunb.) Presl	97-38, 45	55, 55 (64)	84	sex., 2x	3						
Lindsaeaceae						Thelypteridaceae					
<i>Sphenomeris</i> (x = 47, 48, 49)						<i>Thelypteris</i> (x = 27, 29, 30, 31, 32, 34, 35, 36)					
<i>S. chinensis</i> Maxon	97-4	32	c. 190	sex., 4x	5	* <i>T. acuminata</i> (Houtt.) Morton	97-39	49 (64)	72	sex., 2x	12
<i>Lindsaea</i> (x = 44, 47)						<i>T. glanduligera</i> (Kunze) Ching	97-29, 32	28, 28 (32)	108	apo., 3x	11
<i>L. orbiculata</i> (Lam.) Mett.	97-12, 97-13	30, 30 (32)	176	sex., 4x	4						
Sinopteridaceae						* <i>T. parasitica</i> (L.) K.Iwats.	97-23, 25	26, 26 (32)	c. 108	apo., 3x	14
<i>Onychium japonicum</i> (Thunb.) Kunze	97-9, 35	64, 64		sex.		* <i>T. parvifolia</i> Ching	97-5	64	c. 124	sex. ?	13
Adiantaceae						Woodsiaceae					
<i>Adiantum</i> (x = 30)						<i>Deparia</i> (= <i>Athyrium</i> p.p., x = 40, 41)					
<i>A. flabellulatum</i> L.	97-15, 16	61, 61 (64)		sex.		* <i>D. japonica</i> (Thunb.) M.Kato	97-33	64	164	sex., 4x	15
Pteridaceae						<i>Diplazium</i> (40, 41)					
<i>Pteris</i> (x = 29)						<i>D. subsinuatum</i> (Wall.) Tagawa	97-60	64		sex.	
<i>P. ensiformis</i> Burm.	97-6, 18	45, 45 (64)		sex.							
* <i>P. esquiroltii</i> Christ	96-4	30 (32)	c. 90	apo., 3x							
<i>P. semipinnata</i> L.	97-2, 26	50, 59 (64)	116	sex., 4x	6						
Aspleniaceae						Polypodiaceae					
<i>Asplenium</i> (x = 36, 38, 39)						<i>Lepisorus</i> (x = 35, 50)					
<i>A. bullatum</i> Wall. ex Mett.	97-50	64	≥ 130	sex., 4x		* <i>L. thunbergianus</i> (Kaulf.) Ching	97-47	64	100	sex., 4x?	16
Blechnaceae						<i>Microsporium</i> (x = 36)					
<i>Blechnum</i> (x = 31, 33, 34)						<i>M. fortunei</i> (Moore) Ching	97-31	64	c. 72	sex., 2x	17
<i>B. orientale</i> L.	97-1	28 (32)		apo.		<i>Colysis</i> (x = 36)					
<i>Woodwardia</i> (x = 31, 34)						<i>C. pothifolia</i> (Don) Presl	97-43	64	72	sex., 2x	18
<i>W. japonica</i> (L.f.) Sm.	97-14, 46	40, 40 (64)	68	sex., 2x	7						
Dryopteridaceae											
<i>Arachniodes</i> (x = 41)											
<i>A. exilis</i> (Hance) Ching	97-21, 52, 53, 55, 56, 57, 58	48, 48, 48, 48, 47, 50, 50, 50 (64)	82	sex., 2x	8						

The specimens of voucher number from 97-1 to 97-22 were collected from the Forest Park of Fuzhou; 96- and 97-23 to 97-50 from Mt. Gushan, Fuzhou; 97-51 to 97-60 from Linshi Forest center of Fuqing.

S/S: Spore number in each sporangium.

(): estimated spore number in each sporangium based on the practice count.

*: new records from China.



Figs. 13–18. Photographs of somatic chromosomes. Scale bar = 10 μm . 13. *Thelypteris parvifolia* $2n = \text{ca. } 124$. 14. *T. parasitica* $2n = \text{ca. } 108$. 15. *Deparia japonica* $2n = 164$. 16. *Lepisorus thunbergianus* $2n = 100$. 17. *Microsorium fortunei* $2n = \text{ca. } 72$. 18. *Colysis pothifolia* $2n = 72$.

Thelypteris This is an extremely variable genus cytologically. The base number of the genus runs from 27 to 36 (Takamiya 1996). Four species were observed in this study. *Thelypteris glanduligera* has been reported to be $n=54$ (as *Parathelypteris glanduligera*, Weng 1985b), and $n = 68$ in China (Weng and Qiu 1988), and $n = ca.72$ (sex. $4x$) in Japan (Mitui 1968). In the present study, it was confirmed to be $2n = 108$. On account of the base number for the genus $x = 27$ [based on the count by Weng (1985b), $n = 54$], and the spore number 32 in each sporangium, we considered our specimen to be an agamosporous tetraploid. If the basic number for *Thelypteris* is $x = 36$, on the other hand, this individual should be considered an agamosporous triploid. The correct conclusion is expected by the careful examination of karyotype (chromosome genome set) and meiotic division. The second species, *T. parasitica* (*Cyclosorus parasiticus*) has been reported as $n = 72$ ($4x$) from Taiwan and Japan (Sasamoto 1970, Mitui 1975, Kurita 1976, Tsai and Shieh 1983), but it is an agamosporous triploid species with $2n = 108$ chromosomes in Fujian, China. The third species, *T. acuminata*, was newly determined for China to be $2n = 72$ (sex. $2x$, $x = 36$). Finally, *T. parvifolia*, which is an endemic species to Fujian, was observed to have $2n = 124$ chromosomes and 64 spores per sporangium, suggesting it is a sexual tetraploid ($x = 31$).

***Deparia japonica* (= *Athyriopsis japonica*)** This is a morphologically and cytologically variable species. It was reported as hexaploid with $n = 120$ chromosomes from Japan by Kurita (1960) and Mitui (1968), as tetraploid with $2n = 164$ from Malaya and Ceylon by Manton and Sledge (1954) and $2n = 160$ from the western Himalayas by Bir (1962). However, the Chinese materials were determined to have $2n = 164$ chromosomes here, indicating it is a sexual tetraploid.

Lepisorus thunbergianus *Lepisorus* is an extremely variable genus in terms of cytology. Only two species have been observed cytologically in China (Lin et al. 1996).

Lepisorus thunbergianus is cytologically complicated, its chromosome numbers having been variously reported as $n = 25, 50, 2n = 50, 51, 75, 76, 100, 101, 102$ and 103 , including examples of polyploidy and aneuploidy from Japan (Mitui 1966a, b, 1968, 1971, 1975, Takei 1974, 1978, 1982, Masuyama and Mitui 1983, Masuyama et al. 1987, Mitui et al. 1987). In the present study, however, a chromosome number of $2n = 100$ was counted for Chinese materials.

This study was supported by financial aids from the Ministry of Education, Culture, Sports, Science and Technology for Oversea Scientific Program.

References

- Ammal L. S. and Bhavanandan K. V. 1992. Studies on the cytology of some ferns from south India. *Indian Fern J.* **9**: 94–101.
- Bir S. S. 1962. Cytological observations on some ferns from Simla (Western Himalayas). *Curr. Sci.* **31**: 248–250.
- Chiu P. S. 1981. Observations on the chromosome numbers of Chinese ferns. *Acta Phytotax. Sin.* **19**: 451–455.
- Iwatsuki K. 1992. Ferns and Fern Allies of Japan. Heibonsha, Tokyo (in Japanese).
- Kato M. and Nakato N. 1999. A cytotaxonomic study of Hainan (S. China) pteridophytes with notes on polyploidy and apogamy of Chinese species. In: Shing K. X. (ed.), *Ching Memorial Volume*. pp. 1–19. China Forestry Press.
- , ——, Cheng X. and Iwatsuki K. 1992. Cytotaxonomic study of ferns of Yunnan, south-western China. *Bot. Mag. Tokyo* **105**: 105–124.
- Kawakami S. 1979. Karyomorphological studies on Japanese Pteridaceae I, *Dennstaedtia*, *Microlepia*, *Sphenomeris*, *Pteris*. *Bull. Aichi. Univ. of Education* **28** (Nat.): 85–104.
- Kurita S. 1960. Chromosome numbers of some Japanese ferns. *J. Jpn. Bot.* **35**: 269–272.
- 1967. Chromosome numbers of Japanese species of Pteridophyta. *Ann. Rep. For. Stud. Coll., Chiba Univ.* **2**: 41–56.

- 1972. Chromosome numbers of some Japanese ferns (8). *Ann. Rep. For. Stud. Coll., Chiba Univ.* **7**: 47–53.
- 1976. Chromosome numbers of some Japanese ferns (9). *La Kromosomo* **II-2**: 69–76
- Lin L.-G., Zhang Q.-Q. and Huang Y.-R. 1982. Pteridophyta. pp. 5–265. *In*: L.-G. Lin (ed.), *Flora Fujianica*. Fujian Science and Technique Press.
- Lin S.-J., Kato M. and Iwatsuki K. 1990. Sporogenesis, Reproductive Mode, and Cytotaxonomy of Some Species of *Sphenomeris*, *Lindsaea*, and *Tapeinidium* (Lindsaeaceae). *Amer. Fern J.* **80** (3): 97–109.
- , — and — 1996. Cytotaxonomic study of ferns from China I. Species of Yunnan. *J. Jpn. Bot.* **71**: 214–222.
- Manton I. and Sledge W. A. 1954. Observations on the cytology and taxonomy of the Pteridophyte flora of Ceylon. *Phil. Trans., Ser. B* **238**: 127–185
- Masuyama S. and Mitui, K. 1983. Studies on intra-specific polyploids of the fern *Lepisorus thunbergianus* (1): Three distributional patterns in Kanto districts and the occurrence of new cytotypes. *J. Jpn. Bot.* **58**: 195–205.
- , Mitui K. and Nakato N. 1987. Studies on intraspecific polyploids of the ferns *Lepisorus thunbergianus* (3): Mating system and ploidy. *J. Jpn. Bot.* **62**: 321–331.
- Mitui K. 1965. Chromosome studies on Japanese ferns (1). *J. Jpn. Bot.* **40**: 117–124.
- 1966a. Cytological and taxonomical studies on ferns (1). *J. Jpn. Bot.* **41**: 270–276.
- 1966b. Chromosome studies on Japanese ferns (2). *J. Jpn. Bot.* **41**: 60–64.
- 1968. Chromosomes and speciation in ferns. *Sci. Rep. Tokyo Kyoiku Daigaku, Sec. B.* **13**: 285–333.
- 1971. Correlation between the chromosome numbers and morphological characters in the genus *Lepisorus*. *J. Jpn. Bot.* **46**: 83–96.
- 1973. A cytological survey on the pteridophytes of the Bonin Islands. *J. Jpn. Bot.* **48**: 247–254.
- 1975. Chromosome numbers of Japanese pteridophytes. *Bull. Nippon Dental Coll., Gen. Edu.* **4**: 221–271.
- 1976. Chromosome numbers of some ferns in the Ryukyu Islands. *J. Jpn. Bot.* **51**: 33–41.
- , Nakato N. and Masuyama S. 1987. Studies on intraspecific polyploids of the fern *Lepisorus thunbergianus* (2). Cytogeography of main cytotypes. *J. Jpn. Bot.* **58**: 311–319.
- Murakami N. and Iwatsuki K. 1982. Observation of the variation of *Asplenium unilaterale* in Japan with special reference to apogamy. *J. Jpn. Bot.* **58**: 257–262.
- Nakato N. 1990. Note on chromosomes of Japanese pteridophytes (3). *J. Jpn. Bot.* **65**: 204–209.
- and Serizawa S. 1981. Chromosome numbers of the genus *Microlepia* in Japan with description of a new hybrid. *J. Jpn. Bot.* **56**: 161–168.
- , Kato M. and Liu B.-D. 1995. A cytotaxonomic study of some ferns from Jiangsu and Zhejiang Provinces, China. *J. Jpn. Bot.* **70**: 194–204.
- Roy S. K. and Rao A. N. 1985. A brief cytotaxonomic survey of ferns. *J. Singa. Nat. Acad. Sci.* **14**: 53–64.
- Sasamoto I. 1970. Studies of ferns in the Izu-Peninsula. *J. Geobot.* **18**: 68–72.
- Singh V. P. and Roy S. K. 1988. Cytology of forty four species from Sikkim. *Indian Fern J.* **5**: 162–169.
- Srivastava R. P. 1985. Ferns of Indo-Nepal border. *Proc. Roy. Soc. Edinburgh, sec. B. Biol.* **86**: 471–472.
- Takamiya M. 1995. Chromosomal studies of ferns and fern-allies in the republics of Fiji and Vanuatu, South Pacific I. Psilotaceae, Ophioglossaceae, Marattiaceae and Schizaeaceae. *Acta Phytotax. Geobot.* **46**: 137–145.
- 1996. Index to Chromosomes of Japanese Pteridophyta (1910–1996). Japan Pteridological Society.
- , Osato K. and Ono K. 1992. Karyomorphological studies on *Woodwardia* sensu lato of Japan. *Bot. Mag. Tokyo* **105**: 247–263.
- Takei M. 1974. A new cytotaxonomic strain of *Lepisorus thunbergianus*. *J. Jpn. Bot.* **49**: 356–359.
- 1978. On the polyploids of *Lepisorus thunbergianus* (2). Three cytotaxonomic strains in Oita Pref. *J. Jpn. Bot.* **53**: 87–91.
- 1982. Karyological and Karyosystematical studies on Polypodiaceae in Japan (III). *Res. Bull. Fac. Educ. Oita Univ. (Nat. Sci.)* **6** (3): 9–41.
- Tsai J. L. 1992. Cytotaxonomic studies on the fern genus *Microlepia* in Taiwan. *In*: Tsai and Shieh (ed.), *Proceedings of the second seminar on Asia Pteridology Taiwan*. pp. 55–71.
- and Shieh W. C. 1983. A cytotaxonomic survey of pteridophytes in Taiwan. *J. Sci. Engin.* **20**: 137–158.
- Walker F. G. 1985. Cytotaxonomic studies of the ferns of Trinidad. 2. The cytological and taxonomical implications. *Bull. Brit. Mus. Nat. Hist. (Bot.)* **13**: 149–249.
- Wang Z.-R. 1985. Three new cytotypes of *Dryopteris chrysocoma* complex. *Acta Phytotax. Sin.* **23**: 344–351.
- 1989. A preliminary study on cytology of Chinese *Pteris*. *Acta Phytotax. Sin.* **27**: 421–438.
- and Xia Q. 1984. Cytological observations on some species of *Dryopteris* and *Polystichum* from

- China. Acta Bot. Sin. **26**: 24–27.
- and Zhang Z.-X. 1981. Cytological observation on some Chinese ferns. Acta Bot. Sin. **23**: 427–433.
- Weng R. F. 1985a. Chromosome numbers of seven Chinese ferns. Invest. Stud. Nat. **5**: 161–166.
- 1985b. Observation on chromosomes of some Chinese ferns. J. Wuhan Bot. Res. **3**: 367–370.
- 1989. Cytological observations on nine species of *Dryopteris* in China. Proc. Sino-Jap. Symp. Pl. Chromosomes pp. 345–349.
- 1990. Cytological observations on some Chinese ferns. Acta Phytotax. Sin. **28**: 27–33.
- and Qiu P. Q. 1988. Chromosome counts of some ferns from Zhejiang. Invest. Stud. Nat. **8**: 43–52.
- Yoroi R. and Iwatsuki K. 1977. An observation on the variation of *Trichomanes minutum* and allied species. Acta Phytotax. Geobot. **28**: 152–159.

林 蘇娟^a, 莊 惠如^b, 岩槻邦男^c, 盧 海生^d: 中国産シダ類の細胞分類学的研究 II. 福建省の種

中国福建省のシダ植物の細胞分類学的研究をおこなった。18属31種につき孢子数によって生殖様式を推定し、24種の染色体数を明らかにした。そのうち、12種の染色体数は中国での初報告である。特筆すべき知見は以下のようなものである。

中国産のカニクサ属の染色体は未調査であったが、本研究により、*Lygodium microstachyum* と *L. scandens* の染色体数は $2n = 60$ であることが明らかになった。*Pteris esquirolii* は $2n = \text{ca. } 90$ の無配生殖 3 倍体種であり、*P. semipinnata* は $2n = 116$ で有性生殖の 4 倍体であることが従来の $n = 58$ の報告と一致した。オシダ属 *Dryopteris* の 5 種を調べ

た結果、4 種が $2n = 123$ の無配生殖の 3 倍体、1 種が無配生殖の 2 倍体であった。また、シケシダ *Deparia japonica* は日本では $n = 120$ の 6 倍体しか報告されていないが、福建産のものは $2n = 164$ の有性生殖 4 倍体であることが今回の研究で解った。ハシゴシダ *Thelypteris glanduligera* とケホシダ *T. parasitica* は日本ではどちらも $n = 72$ の有性生殖の 4 倍体であったが、福建省産のものは 2 種とも $2n = 108$ で無配生殖の 3 倍体であることがわかった。(°東京大学大学院理学系研究科生物科学専攻, °福建師範大学生物工程学院, °放送大学)